Environmental Health Perspectives Supplements 101(Supp 3): 275-277 (1993)

Birthweight Below the Tenth Percentile: The Relative and Attributable Risks of Maternal Tobacco Consumption and Other Factors

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Analysis of 7776 singleton births defined a cohort of babies with birthweight below the 10th percentile after adjusting for gestational age and sex. The relative risk of a baby being small for gestational age in respect to a number of factors, such as parental anthropometry, demographic factors, behavior patterns (tobacco, cannabis, alcohol, and caffeine consumption), maternal pathology, and fetal abnormality, was calculated The highest relative risks are associated with severe antepartum hemorrhage, severe pre-eclampsia, and severe fetal abnormality. As these are relatively rare events, a more accurate calculation of overall risk to the population as opposed to the individual can be obtained by studying the percent attributable risk of each of the factors. This demonstrates that maternal tobacco consumption is the major environmental risk factor in our population.

Introduction

The phrase “birthweight below the tenth percentile” is internationally used to define a particular group of babies who have significantly increased perinatal mortality and morbidity rates, although these rates vary between different populations. A number of synonyms are also used to describe this group. These include ‘intrauterine growth retardation” as defined by the World Health Organization, “small for gestational age,” where specific allowance is made for gestation, and more precisely “small for gestational age and sex” (SGAS), where the effect of gender on birthweight is also taken into account, and we use SGAS in this paper.

It is obvious that any baby’s birthweight is a balance between two major factors. One is the genetic potential derived from parents, particularly the mother. The other is environment of the developing fetus, which can be modified by a vast variety of factors and may be integral to the mother or fetus or the external environment of both. This paper examines a number of factors and their associations with SGAS babies.

Survey Methods

The data are derived from a prospective, longitudinal, collaborative study of pregnancy at the University of Queensland in which 8556 consecutive antenatal patients were enrolled and information gathered via questionnaires at the first clinic visit, 3 days after delivery, and 6 months after delivery, as well as a comprehensive clinical evaluation of the mother and baby. These data sets consisted of 117, 103, 103, and 97, items, respectively. The details of methodology and compliance rates have been previously published[1,2].

Statistical Methods

The babies were ranked by birthweight within each gestational age and sex category. Those within the first decile were defined as SGAS—the dependent variable. Logistic regression was used to examine a number of prediction models (loosely grouped as

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parental anthropometry, demography, lifestyle, pregnancy pathology, and fetal pathology) for SGAS, and the odds ratio and 95% confidence limits were estimated. The significance of individual factors was assessed by the likelihood ratio statistic, both for trend and variation.

Results

Parental Anthropometry. Low maternal height, low maternal weight (as body mass index) and low weight gain in pregnancy were all significantly associated with SGAS, as also was low paternal height but not low paternal weight, These results confirm our previous findings that paternal height has a significant effect on birthweight[3].

Demography. Maternal age was nonsignificant, but maternal race and parity (in descending birth order) were significantly associated with SGAS. Family income was not an important factor in SGAS, a point we have previously made with regard to socioeconomic status, in respect to birthweight in our Australian population, and this is probably a reflection of the general affluence of all sections of the community[4].

Lifestyle. Cannabis/caffeine and alcohol consumption was nonsignificant. Rarely or never eating breakfast was, however, significantly associated with SGAS and presumably reflects a variety of lifestyle variables. Cigarette smoking was highly significant, and the risk ratio for SGAS rises progressively with increased cigarette consumption.

Pregnancy Pathology. The major diseases of pregnancy — essential hypertension, pre-eclamptic toxemia, and antepartum hemorrhage — had no significant association with SGAS in our population, probably due to the small numbers and active obstetrical management.

Fetal Pathology—severe developmental defects and, more particularly, chromosomal abnormalities—had significantly increased risk ratios for SGAS.

Discussion

Figure 1 summarizes the risk ratio of a baby being SGAS in relation to the previous factors and demonstrates a descending order from major fetal abnormality through cigarette smoking, antepartum hemorrhage, various aspects of maternal anthropometry, and a series of relatively minor variables. However, these data only show the risk of an individual baby being SGAS where these factors pertain. What we really need to know is the epidemiological or “global” effect of these factors in relation to SGAS, an aspect that does not appear to have been previously considered We have therefore used a formula derived from Kahn and Sempos[5], which combines both the effect and the frequency of the variable, to derive the population percent attributable risk. These results (Fig. 2) clearly demonstrate that parental anthropometry and cigarette smoking are by far the most common factors associated with SGAS.

In conclusion, in our population, maternal cigarette smoking is the major preventable factor in SGAS babies and as such is a major cause of perinatal mortality and morbidity.

Figure 1: Average risk ratio of small for gestational age and sex infants

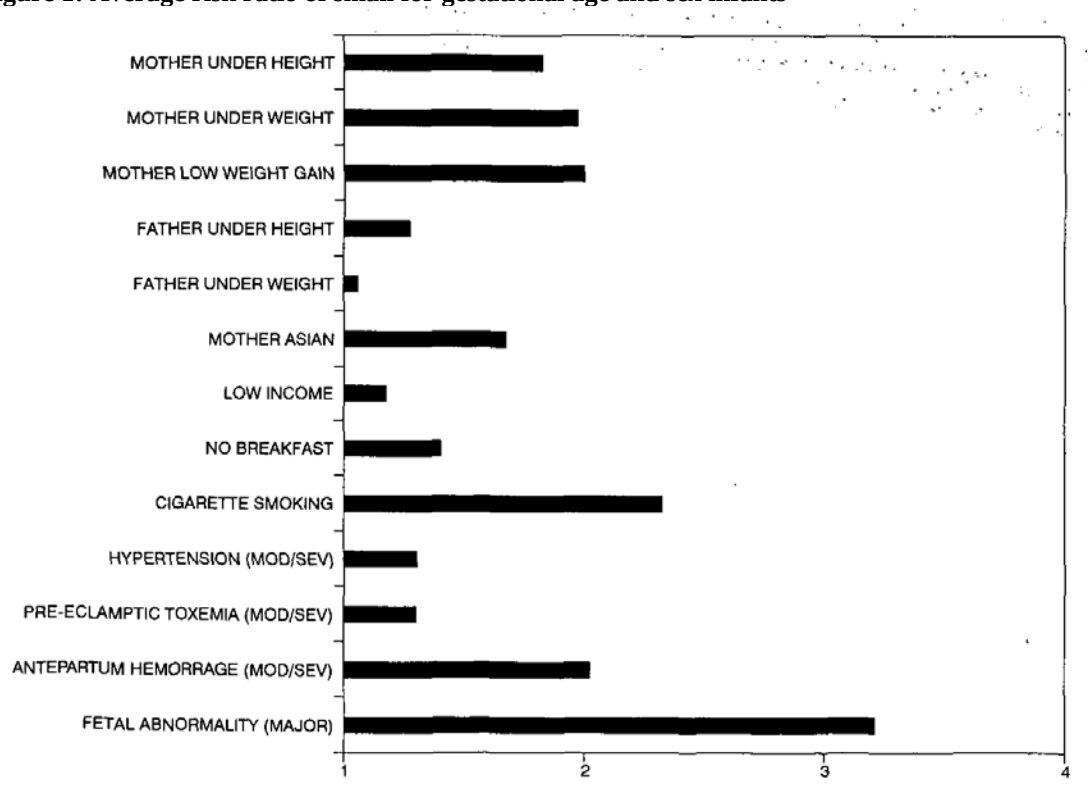
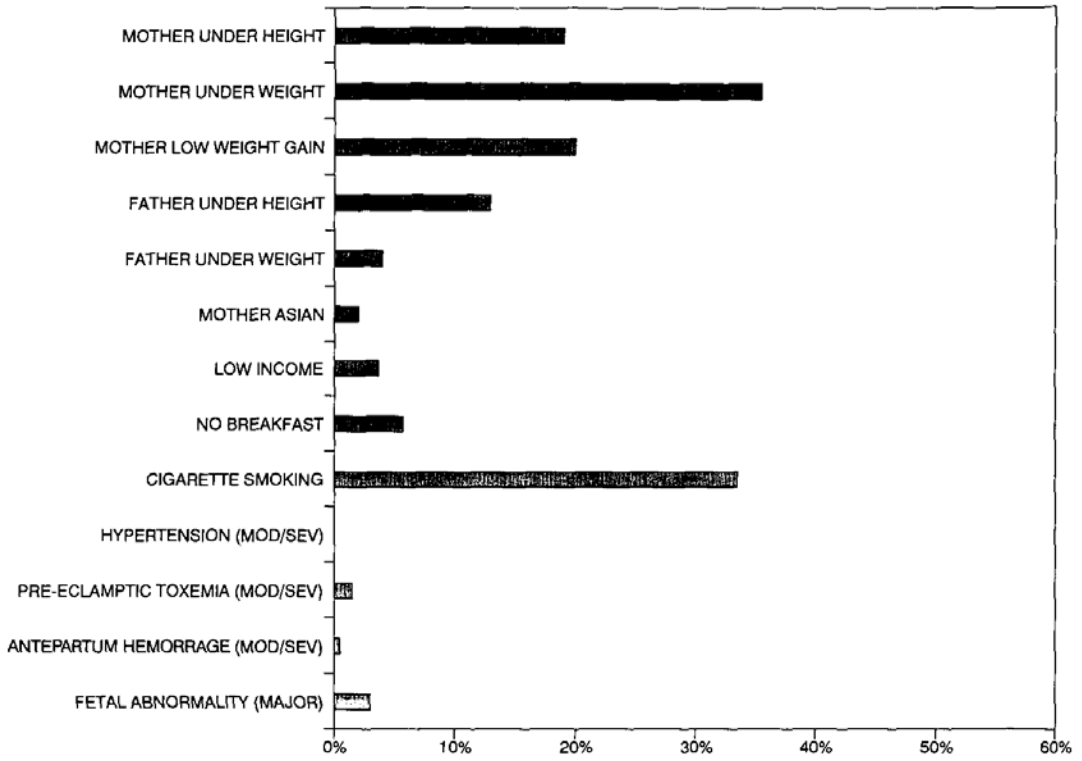


Figure 2: Percent attributable risk of small for gestational age and sex infants



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